



UNITED STATES PATENT AND TRADEMARK OFFICE

16

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
-----------------	-------------	----------------------	---------------------	------------------

10/731,860	12/09/2003	Sei-Hyung Ryu	5308-278	4232
------------	------------	---------------	----------	------

20792	7590	04/19/2005
-------	------	------------

MYERS BIGEL SIBLEY & SAJOVEC
PO BOX 37428
RALEIGH, NC 27627

EXAMINER

NGUYEN, THINH T

ART UNIT	PAPER NUMBER
----------	--------------

2818

DATE MAILED: 04/19/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/731,860

Applicant(s)

RYU ET AL.

Examiner

Thinh T. Nguyen

Art Unit

2818

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 07 March 2005.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-21 and 42-47 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-21 and 42-47 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 09 December 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED OFFICE ACTION

1. Applicants' election of claims 1-21 and 42-47 for prosecution without traverse in the communication with the Office on 3/7/2005 is acknowledged.

Specification

2. The specification has been checked to the extent necessary to determine the presence of all possible minor errors. However, the applicant cooperation is requested in correcting any errors of which the applicant may become aware in the specification.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102(b/e) that form the basis for the rejections under this section made in this office action.

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

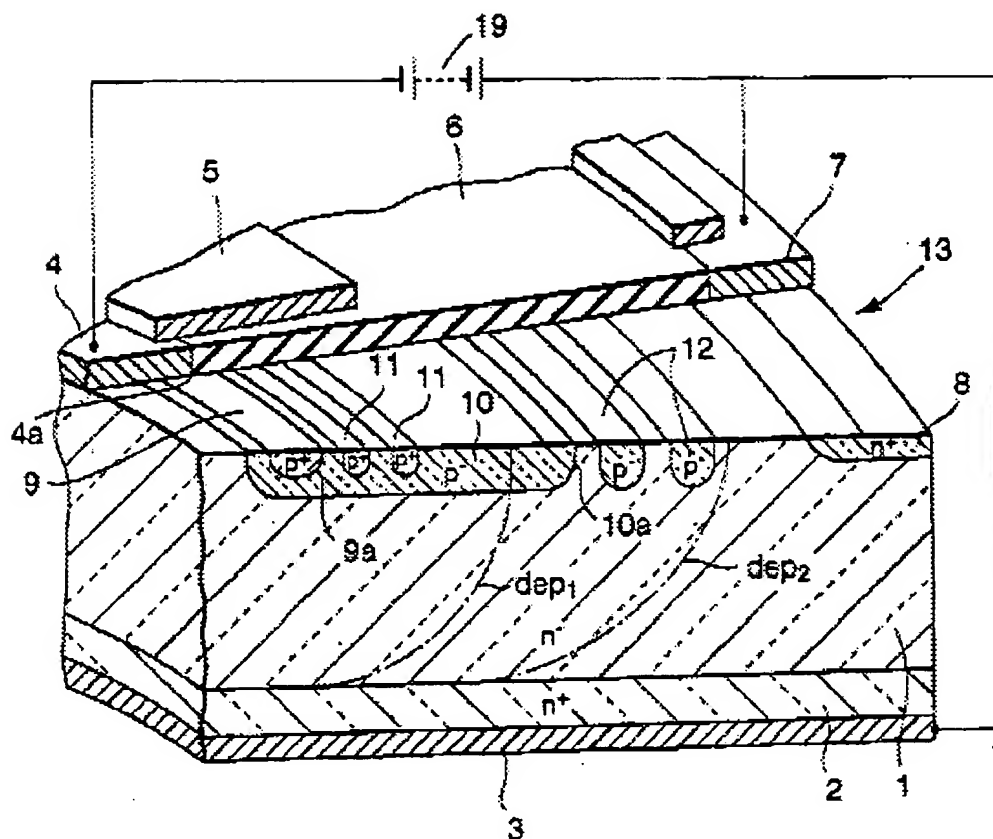
(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

4. Claim 1,3,4,6,8-9,20,42,46 are rejected under 35 U.S.C. 102(e) as being anticipated by Kinoshita et al. (U.S. Patent 6,831,345).

REGARDING CLAIM 1,42

Kinoshita discloses (the abstract, fig 1, column 3 line 3) an edge termination structure for a silicon carbide semiconductor device, comprising: a plurality of spaced apart concentric floating guard rings (fig 1 layer 11) in a silicon carbide layer that at least partially surround a silicon carbide-based semiconductor junction; an insulating layer (fig 1 layer 6) on the floating guard rings; and a silicon carbide surface charge compensation region (fig 1 region 10) between the floating guard rings and adjacent the insulating layer or an edge termination structure for a silicon carbide semiconductor device, comprising: a plurality of spaced apart concentric floating guard rings (fig 1 layer 11) in a silicon carbide layer that surround at least a portion of a silicon carbide-based semiconductor junction; an insulating layer (fig 1 layer 6) on the floating guard rings; and means (fig 1 region 10) for neutralizing effects of charges at an interface between the insulating layer and the silicon carbide layer in the region of the floating guard rings.

FIG. 1



REGARDING CLAIM 3

Kinoshita discloses (the abstract, fig 1) an edge termination structure, wherein the surface charge compensation region 10 is doped lighter (p -) than the guard rings 9a (p +)

REGARDING CLAIM 4,8

Kinoshita discloses (the abstract, fig 1) an edge termination structure, wherein

the surface charge compensation region (fig 1 region 10) extends completely between adjacent ones of the floating guard rings and comprises a single region that overlaps the floating guard rings.

REGARDING CLAIM 6,9

Kinoshita discloses (column 12 line 28) that the surface charge compensation region comprises implanted regions in the silicon carbide layer and this disclosure also effectively anticipated claim 9 of a structure having SiC layer on a SiC substrate.

REGARDING CLAIM 20

Kinoshita discloses (the abstract, fig 1) an edge termination structure, wherein the silicon carbide layer is an n-type silicon carbide layer and the guard rings and surface charge compensation region are p-type silicon carbide.

REGARDING CLAIM 46

Kinoshita discloses (the abstract, fig 1) an edge termination structure, wherein the means for neutralizing comprises a surface charge compensation layer (layer 10) between adjacent ones of the guard rings.

Claim Rejections - 35 USC § 103

5. The following is a quotation of U.S.C. 103(a) which form the basis for all obviousness rejections set forth in this office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Art Unit: 2818

6. Claims 2,10-19,43,45,47 are rejected under 35 U.S.C. 103(a) as being unpatentable over Akiyama (U.S. patent 5,994,189) in view of further remark.

REGARDING CLAIM 2

Akiyama discloses (the abstract, fig 8) discloses all the invention including charge compensation layers that has less depth than the ring layer except the specific teachings about using a Silicon Carbide substrate. This feature, however, is old and well known in the art because Silicon Carbide has been used in addition to Silicon as substrate for power device with improved performance in Semiconductor manufacturing

It would have been obvious to one of ordinary skill in the art the time the invention was made to use the teachings by Akiyama et al and all his own routine design skill in order to come up with the invention of claim 2 for a purpose of improving the semiconductor device invented by Akiyama.

REGARDING CLAIM 10-19,43,45,47

Akiyama discloses (the abstract, fig 8) discloses all the invention except going into details about the dose, the dimension and the numbers of the guard rings, etc. These features, however, are considered obvious since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable range involves only routine skill in the art.

A detailed cross-sectional view of a semiconductor device. The structure consists of several layers and regions. At the top, there are two main contact areas. The left area includes a gate stack (7, 10) and a source/drain region (6, 30) with a p⁺ sub-region. The right area includes a gate stack (9, 3) and a source/drain region (4, 11) with an n⁺ sub-region. Between these are several p-type regions (5, 20, 30, 10, 30) separated by p⁻ regions. The bottom of the device features a p⁻ layer (1) with an n⁺ layer (8) on top, and a p⁺ layer (13) at the very bottom. Various other layers and regions are labeled with numbers (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 20, 21, 30) and letters (A, B, C). The device is shown with electrical contacts (O+V) and a dashed line indicating a cross-section through the center.

REGARDING CLAIM 5

Trajkovic discloses (the abstract, fig 2) all the invention including the surface charge compensation region that extends between adjacent ones of the floating guard rings but does not extend completely between two adjacent floating guard rings except for specific teachings about using a Silicon Carbide substrate. This feature, however, is old and well known in the art because Silicon Carbide has been used in addition to Silicon as substrate for power device with improved performance in Semiconductor manufacturing.

The rationale why claim 5 is obvious over Trajkovic has been discussed in the rejection of claim 2 in the previous section of the Office Action.

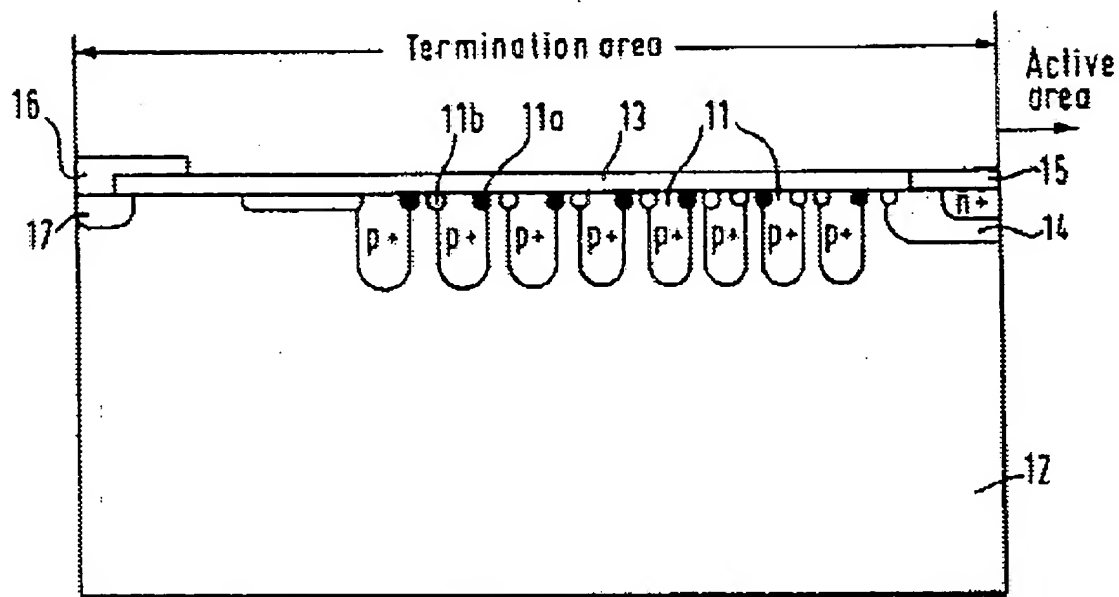


Fig.2.

REGARDING CLAIM 7,44

Trajkovic discloses (the abstract, fig 2) all the invention including a plurality of compensation regions (regions 11 in fig 2) adjacent to the guard rings except for specific teachings about using a Silicon Carbide substrate. This feature, however, is old and well known in the art because Silicon Carbide has been used in addition to Silicon as substrate for power device with improved performance in Semiconductor manufacturing.

The rationale why claim 7 is obvious over Trajkovic has been discussed in the rejection of claim 2 in the previous section of the Office Action.

8. Claim 21 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kinoshita et al (US patent 6,831,345) in view of further remark.

Even though Kinoshita et al. only discloses a n-substrate device, it is old and well known in the art that a p-substrate device with the polarity of all the layers change to the opposite polarity will work as well.

It would have been obvious to one of ordinary skill in the art the time the invention was made to use the teachings by Kinoshita et al and his own routine design skill in order to come up with the invention of claim 21 for a purpose of expanding the use the semiconductor device invented by Kinoshita for more profitability.

9. When responding to the office action, Applicants are advised to provide the examiner with the line numbers and the page numbers in the application and/or references cited to assist the examiner to locate the appropriate paragraphs.

10. A shortened statutory period for response to this action is set to expire 3 (three) months and 0 (zero) day from the day of this letter. Failure to respond within the period for response will cause the application to be abandoned (see M.P.E.P. 710.02(b)).

CONCLUSION

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thinh T Nguyen whose telephone number is 571-272-1790.

The examiner can normally be reached on Monday-Friday 9:00am-6:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Nelms can be reached at 571-272-1787.

The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Thinh T. Nguyen



Art Unit 2818



David Nelms
Supervisory Patent Examiner
Technology Center 2800